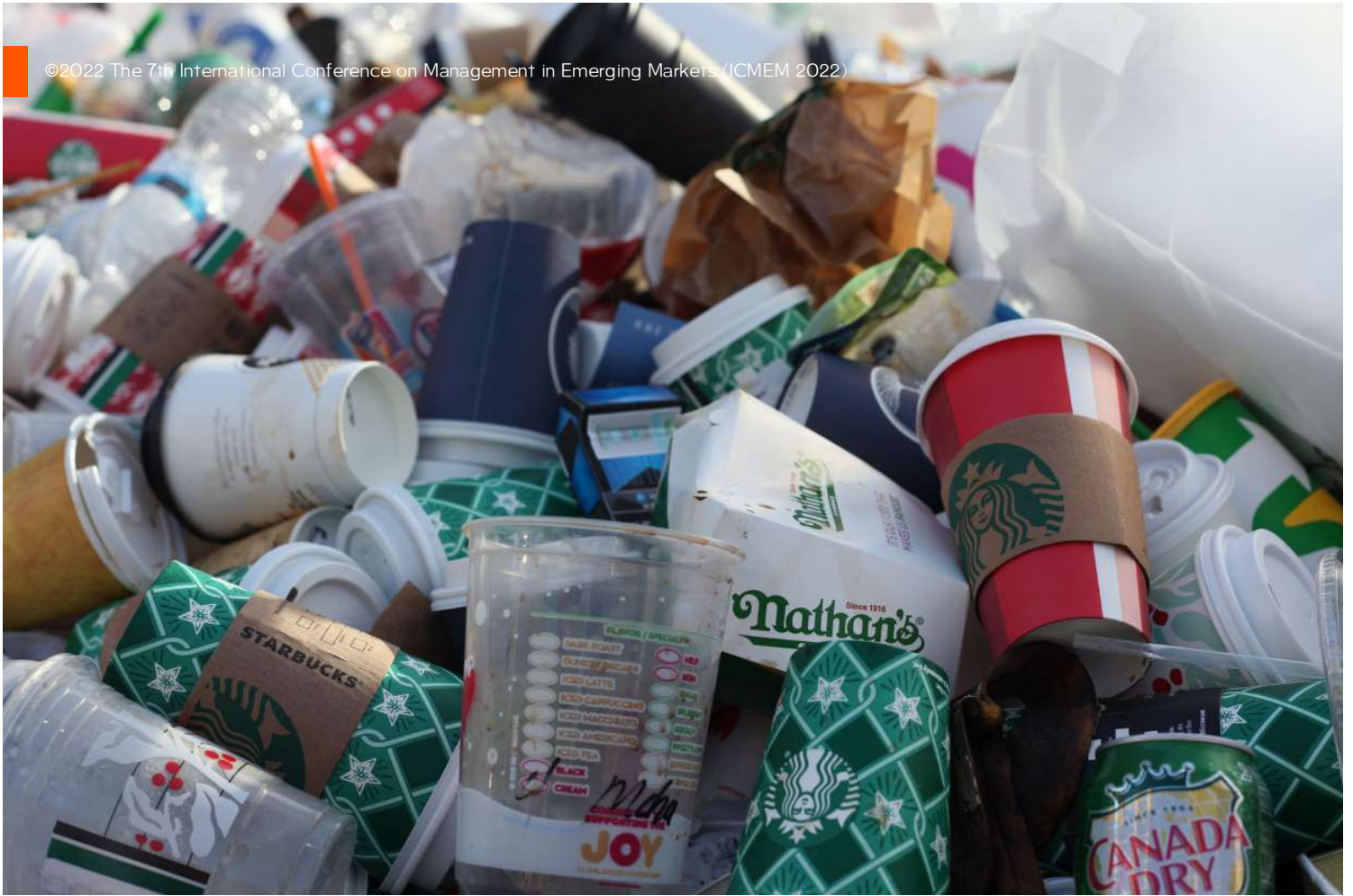




Paper 52

Transitioning to Effective Waste Management In
Supporting the Creation of Sustainable Food Supply
Chain in Bandung Regency

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ICMEM

The 7th International Conference on Management in Emerging Markets

Abstract - Achieving sustainable food supply chain is one of the goals of Bandung Regency's Government. However, currently, 43% of total waste in Bandung Regency is food waste. Meanwhile, products that are considered as food waste actually can be utilized more optimally through effective waste management. Therefore, this study aims to develop effective food waste management by first identifying the current food waste management in Bandung Regency's Food Supply Chain. The research method used is a soft system methodology, with data collection done through interviews with related stakeholders. The results show that food waste management in Bandung Regency's Agriculture Supply Chain has not been implemented optimally even with assistance and support from the government and NGOs. This is because implementing food waste management involves changing habits in society. In addition, the absence of things that can motivate the community and the many obstacles in its implementation make the society reluctant to make changes. Therefore, this study recommends a transformation to answer the gap which is summarized in a conceptual model that refers to the ADKAR framework.

Keywords- Changing Habit, Effective Waste Management, Food Waste, Sustainable Food Supply Chain

I. INTRODUCTION

According to the Food Waste Index 2021 [1], by UNEP the number of food wasted globally in 2019 reached up to 931 million tons a year and about 17% of the total global production are contributing to this huge amount of waste. Whereas the food is wasted, unfortunately there are lot of negative effect due to the existence of food waste starting from social problem related to hunger [2] to environment problem that lead to global warming [3], [4]. In response to this problem, the United Nations has included the problem of food waste as one of the goals in the 2030 Agenda for Sustainable Development, namely SDG 12 regarding responsible consumption and production.

Indonesia, which is committed to contributing to the sustainable goal, is also trying to make efforts to establish a more sustainable production and consumption system [5]. One of the area that is being pursued to reduce food waste is the Bandung Regency, which is known as one of the regions that have advantages in agriculture sector. However, currently, the production of agriculture products

have not been fully maximized and utilized [6], as the percentage of food waste reaching 43%, the same as the largest waste contribution [7].

In response to this problem, BAPPEDA is trying to develop a more sustainable food supply chain to be applied in Bandung Regency. The effort that is currently being planned is creating a food hub. However, this food hub creation is only focusing on the prevention action. Meanwhile in food waste management, both prevention and handling of waste is necessary. However, currently, there is no data or research about the current food waste management in Bandung Regency's Food Supply Chain. Therefore, this research will focus on identifying food waste in Bandung Regency's Food Supply Chain in terms of supporting the establishment of a more sustainable food supply chain.

II. LITERATURE REVIEW

In conducting the research, the theoretical review is done to gain knowledge and perspective in understanding the existing research on relevant topics and/or area.

A. Creating Sustainable Food Supply Chain

The term sustainable supply chain has meaning supply chain management that focuses on being able to maintain the ability to meet current and future needs in the economic, social, and environmental spheres [8]. Whereas, supply chain itself is the process of maximizing the value generated in the business while fulfilling customer demand [9]. Therefore, the definition of sustainable agriculture or food supply chain leads to the process of maximizing value generated in the agriculture or food sector but also considering how to maintain the current ability to meet demand in the future.

In the implementation, there are fundamental differences between food supply chain and other supply chains that also must be considered. First, the unique characteristic of food which is perishable and continuously changing quality [10], especially in fresh agricultural products. Besides, not only is the quality itself changing naturally, but the perception of each customer toward the quality of food products also tends to be different [11]. Unfortunately, these unique characteristic has also brought problem to the food supply chain [12], [13], including food loss and waste. Addressing the problem of food loss and waste is

said to be one effective way to start forming a sustainable supply chain [14].

Some of the efforts that are currently being made are related to supply chain efficiency or related to the waste prevention effort. As mentioned by Hanson et al [15], management problem in the supply chain process are also contributed to generating food waste. The example efforts of increasing supply chain efficiency are optimizing the production factor such as infrastructures [16], forecasting to avoid overproduction [17], shortening the supply chain [18] or by building coordination among supply chain actors [19], [20].

However, in creating a sustainable supply chain, waste prevention action is not enough. As the current economic system that is still widely used today, the linear economy [21] that discarding all things that are no longer used or wanted, is also naturally increasing the number of waste including food waste [22]. In addition, the high number of waste that has been collected in the landfills will also keep increasing due to the increase in population, meanwhile, the capacity of landfills is limited. Therefore, efforts in handling waste specifically in utilization of waste are increasingly becoming necessary, including in this research context food waste management.

B. Food Waste Management

One of the reasons that waste management has not been carried out effectively is due to the ambiguity of what is actually waste as there is no clear agreement on the meaning of waste [23]. Therefore, in order to make waste management effective in this context is food waste, it is necessary to have a proper understanding of food waste management as a whole.

Food Waste – Food waste which is considered to be one type of waste that is not separated or specified in more detail. Meanwhile, food waste is also related to other similar terms that are often considered to have the same meaning such as “food loss” and “surplus food” [24]. While, these terms actually refer to a different meaning, although it is undeniable that they have the potential to turn into food waste [13], [25].

Some researchers define food waste as all food that can actually be eaten but is not consumed and thrown away [26], [27], which is related to the term “surplus food”. Meanwhile, there is also definition that is related to “food loss” that defines food waste as food that undergoes the process of degradation or destruction at any stage of the supply chain starting from the upstream to the downstream [26]. Last, food waste also defines as all food as well as associated with inedible parts, that is removed from the food supply chain to be recovered or

disposed of [15], [28]. This definition seemed to be the most appropriate definition that can cover the previously mentioned definition and also the context of this research. As it is also mentioned that both inedible and edible parts of food can be used by all stakeholders therefore both of them must be considered in terms of ensuring the efficiency of sustainability efforts [28].

Despite the broad definition of food waste, the waste can be identified in more detail. One of the ways to identify waste that can support waste management is by categorizing or classifying as mentioned by some researchers, as it can support in order to find the most appropriate waste management alternative [29]. One of the most common food waste categorizations is based on the edibility and possibility of avoidance [24], [28], [30]–[33].

Based on edibility, generally, there are two categories for the type of food waste, namely edible and inedible [32], [34]. Edible waste refers to all parts of food that can be eaten by humans however due to various reasons, the food is not sold or consumed. Whereas inedible waste typically refers to by-products obtained during production at farms or manufacturing. Based on the possibility of avoidance, there is three categories type of food waste, namely avoidable, possibly avoidable, and unavoidable waste [32], [35], [36]. Avoidable food waste refers to all food or parts of food that are considered edible by the vast majority of people but thrown away because it is no longer wanted or has passed the consumption period. Meanwhile, unavoidable food waste is food waste that arises from food that is not and cannot be eaten under normal circumstances such as fruit skin, bones, eggshell, etc.

Teigiserova, Hamelin, and Thomsen [24] made a simple matrix to categorize food waste into six distinct categories, namely edible, naturally inedible, industrial residue, inedible due to natural causes, inedible due to ineffective management and not accounted for. The matrix can be seen in Table 1.

Food Waste Management based on Waste Hierarchy – Food waste hierarchy shows how food waste should be handled based on its condition. With the implementation of this food waste hierarchy, waste management can be maximized, especially in reducing the negative impact on the environment [37].

The food waste hierarchy is usually connected to the R Principles as well. The most common and practical R principle that is used and mentioned in some research in managing food waste is the Four R Principles, namely reduce, reuse, recycle and recovery [38]. Reduce principle

Table 1 - FOOD WASTE CATEGORIZATION

Edible		Inedible	Other	
Avoidable		Unavoidable	Partly Avoidable	
All Food	Edible	-Naturally inedible (part of the products) -Processing waste residues	-Inedible due to natural causes -Inedible due to inefficient management	Not accounted for
Surplus		Food Waste		Food Loss

or sometimes also called prevention is referring to the activity of waste by reducing the input of virgin resources [39]. Whereas, "Reuse" is an effort of reduction by further using the product for a similar original purpose or function which is consumption. Recycling refer to the process of collecting and dismantling used products, components, and materials, separating them into categories, and processing them to be recycled [39], [40]. The last R-principle to be



implemented in the food waste hierarchy is recovery. Recovery is the treatment of food waste especially unavoidable waste for energy recovery [38]. Finally, disposal in landfills is the least preferred option for managing waste as there is no treatment for food waste. Fig. 1 Food Waste Hierarchy shows the level preferable of waste from the reduce principle to disposal.

If taken into deeper analysis, it can also be seen in the food waste hierarchy diagram, that the raw materials (mentioned as the feedstock in Fig. 1) at each level are different from one level to another. The different treatment is not only due to the condition of the waste but also the value of the waste [39]. Therefore, in order to find the optimal waste management alternatives, prior identification regarding food waste is also needed.

Toward Effective Food Waste Management - Only considering the technical aspect of the utilization of waste is not enough in creating effective food waste management. There are other aspects that need to be considered to make food waste management implemented effectively.

The problem of food waste itself is complex and comprises three problem conditions, namely unstructured, cross-cutting, and relentless [41]. This complex problem cannot be overcome by only certain stakeholders, it needs participation from all stakeholders as the problem itself is related to all stakeholders and cannot be solved all at once. This statement is also aligned with other research as mentioned by Allison et al. [42], Sasinovich [43], and Filimonau and Ermolaev [44].

In order for stakeholders to play a role in food waste management, it is important to determine in advance where waste can be generated and which stakeholders can be responsible for the waste generated [45]. Therefore, in this research, it is also carried out first on how the current conditions of food waste management in each actor's supply chain.

In addition, food waste management also implies the relationship of managing waste with human behavior that needs to be taken into consideration as well. The reality is that waste management is not the behavior of today's society, so intervention is needed so that this activity can be carried out [41]. Allison et al. [42], mentioned that human behavior itself is influenced by three aspects namely motivation, capability, and opportunity. According to his research, it is proven that motivation indeed leads people to do waste management, however, some barriers that is still existed also made waste management not effective can be seen from the people's response of not doing some of the waste management efforts.

In other research, barriers and drivers are also mentioned to influence the implementation of food waste management. Some of the barriers that are often mentioned as impeding the implementation of waste management are lack of awareness, lack of skills and knowledge, and inconvenience of implementation [46], [47]. Whereas the drivers of utilizing waste are psychological motives of actors such as feeling guilty, economical motives not to waste money, and knowledge toward the utilization of waste [46]–[48]. It is also mentioned that identifying these drivers and barriers, as well as trying to address them will lead to the implementation of more effective food waste management. Therefore, this research will also try to identify the barrier and driver of the food waste management.

III. METHODOLOGY

A. Research Method

The research method that is used in this research is the soft system methodology that was developed by Checkland [49]. The soft systems methodology itself is an approach that could help to model the human activity

system which is still unstructured and has problem due to the different perceptions of various perspectives.

Since this research uses the soft system methodology approach, therefore the step in carrying out the research will adopt the steps that had been conducted by Checkland [49]. There is a seven-stage model of SSM. The Fig. 2 represents how the research is carried out.

Based on the Seven Stages of SSM, it can be seen that comprehensive understanding of the Bandung Regency's agriculture supply chain must be obtained in the first place through real-world point view. The result of the analysis regarding the problem is described in form of a rich picture. A rich picture is a tool that can be used to represent the real-world situation comprehensively as it could contain

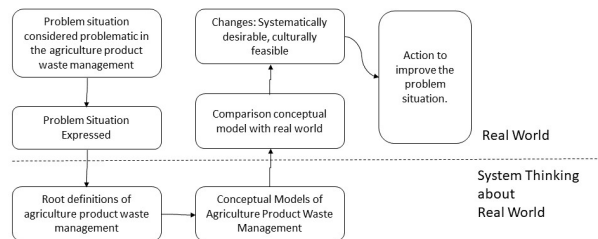


Fig. 2 Seven Stages of SSM

information about the primary stakeholders involved, relationship between stakeholders, and also their concerns that may become the place where problems occurred [50].

After the real situation of food waste management in Bandung Regency's agriculture supply chain is understood, key activities and problem that relate to the problem must be identified in order to create the desire conceptual model [49]. This step is called as root definition. CATWOE framework is used as tool to define the emergent property of the desire condition [51]. The property referred in this framework are customers, actors, transformation, welstanchauung (world view), owner and environment [52]. From all of these elements, the transformation element is the core of the analysis since the objective of SSM research is to generate action recommendation in achieving desired condition that is derived from real world situation [53].

After defining the root definition, conceptual model is developed to represent the way how transformation toward the ideal systems can be achieved, in this research context is the effective food waste management implementation in Bandung Regency's agriculture supply chain. Thus, this research is only conducted until the stage 4 namely the conceptual model formation.

B. Data Gathering

In terms of data gathering, primary data, which collected from interview, is the main source of answering the research questions. Whereas secondary data which is obtained from existing literature, is used as supporting data related to food waste management, reference for making the interview protocol, and for building the conceptual model.

Semi-structured interviews with purposive sampling were conducted with 27 respondents who were involved and related to the supply chain and handling of agricultural product waste in Bandung Regency. The interviews were conducted face-to-face and by telephone. The average duration of the interview was 30 minutes to 1.5 hours. Some additional interviews were also done in order to collect additional information.

Before analysis, all data that has been collected were documented systematically and coded to ease the analysis. Coding is done using combinative coding method which enables researcher to prevent the risk of making the data too complicated, however at the same time researcher can still open to new findings [54]. New findings will then be validated through literature.

IV. DISCUSSION

A. The Real-World Situation of Bandung Regency Food Supply Chain

Actor in Supply Chain Perspectives - Based on the data obtained and references to several studies, there are three main actors who are directly involved in the supply chain of agricultural products, namely farmers, intermediaries,

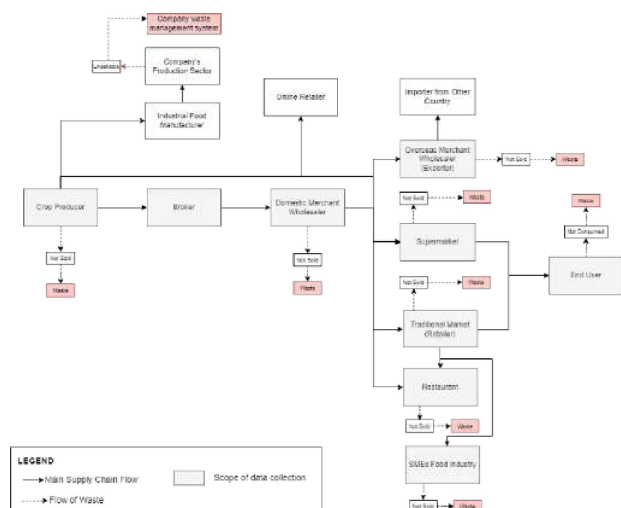


Fig. 3 Current Bandung Regency's Agriculture Supply Chain

and consumers. Each actor has a different role and activity in the supply chain. Although it appears that agricultural products flow from farmers as producers to final consumers, not all products can end up in consumers or in other words sold. Based on the data obtained, most of the unsold products are thrown to waste. In fact, not all of these products are in poor condition, and even some of them still have a quality that is worth selling in the market. Based on their condition, these unsold products can be grouped into three general categories according to the matrix in Table 1 that has been discussed in the previous section, namely surplus food, food loss, and food waste.

Realizing the value remained in unused product, these products can become more useful and reduce the increase in the amount of waste, if treated following the food waste hierarchy. However, due to several constraints and other problems such as limited financial capacity, limited utilization of knowledge, etc.; from the many potential uses of unused products, the actors still have not implemented it much, it can be seen in Fig. 3, these products only end up as waste.

Meanwhile, according to the interviews with the government, independent waste utilization by society was indispensable. Considering the fact that it was impossible to handle waste if it was only carried out by the government unilaterally due to limitation in resources. One example of this limitation from the government can be seen in the lack of waste handling facilities in the Bandung Regency which could only cover 16.32 % of the total waste in 2018 [55], even decreased in 2019 due to the increasing amount of waste generation.

Efforts that have been made by the government to enable citizens to play an active role in reducing are waste is various, ranging from efforts to reduce waste production

due to supply chain inefficiency, namely by forming clusters to build collaboration between actors in the supply chain, waste utilization by building waste processing units in various areas, directly providing tools for processing waste to residents such as bio-digesters, and others.

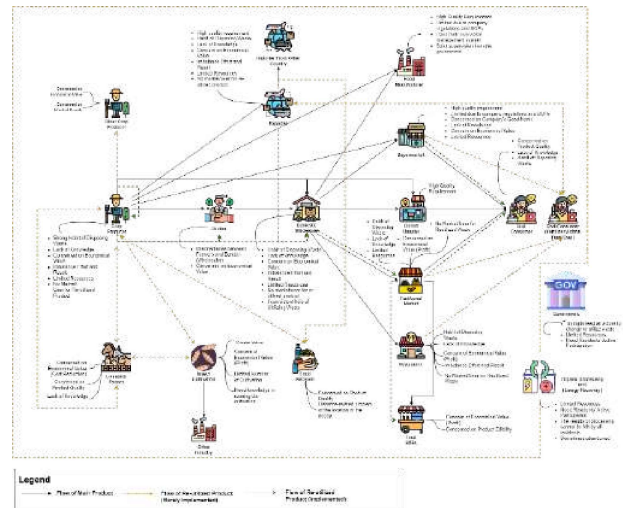


Fig 4 Rich Picture

However, in reality, people are still not used to managing waste, even though the implementation were assisted by organizations, the percentage of people who were actively involved in undergoing the program only reaches 40%. Even when they are no longer accompanied, people tend to leave the program completely.

The constraints experienced by actors and the priority concerns of actors make it difficult for them to utilize waste and choose to dispose of waste. Fig. 4 Rich Picture shows the problematic situation of the supply chain of Bandung Regency's agricultural products and the handling of waste.

B. Root Definition

Previously, it was explained that the government has been trying to change the way society managed waste, which is usually disposed of the waste directly. Of the many obstacles and concerns mentioned in Fig. 4, it can be concluded that the difficulty of the change effort is because it is related to people's habits, namely the habit of handling waste. The habit of today's society is to immediately throw away any product that is considered useless. Meanwhile, what the government wants to implement is the exact opposite of the current habits. This is a major obstacle because in fact this habit has been going on for a very long time and is continuously being carried out.

However, other obstacles also contribute to making people reluctant to utilize waste. Lack of public awareness of the importance and urgency of the waste problem as well as public knowledge about waste management becomes barrier in food waste management. This can be identified when the interviewees said that they did not feel any negative impact from the presence of such waste and even some of them said that littering was a normal habit. In addition, not a few of them are completely

unaware that the waste they dispose of actually still has value and can be processed and utilized.

This problem was also directly verified by the government and Non-Governmental Organizations (NGOs) working in the solid waste sector. The number of programs and facilities that are often abandoned, cannot be separated from this problem.

However, not all people do not have awareness of the waste problem and its potential to be utilized. There are still some people who have tried to utilize the "useless" product. But, because the results were not commensurate with the effort made and/or the benefit do not look meaningful for them, they also decided to return to the old habit of disposing the waste.

The problem is also related to the concern of the society, namely the economic value of the results of the waste utilization. Based on interviews, some actors even said directly that they may continue to process or utilize waste if the results can be of economic value which can provide them with additional income. However, because of the benefits of utilizing waste, which is currently perceived as only being dominant in the environmental aspect, they are not interested in doing so. In addition, cost which sometimes even increases due to the effort of utilizing the products, makes them even more reluctant.

Still related to constraints on the economic aspect, market or distribution difficulties of re-utilized products also becomes of the barriers of food waste management. For example, one of the informants who once made an effort to reduce waste by recycling them into fertilizer, decided to stop because no one wants to receive it even for free. In addition, it created new problems such as additional costs and the accumulation of waste collected that invites pests.

The last obstacle experienced by actors in utilizing or reducing waste is limited resources. The resources in question vary, ranging from time, funds, and people, to technology. Based on the interview, the main resource limitation is in terms of time. The supply chain actors are already too busy and choose to focus on managing the interests of their main activities which are clearly more productive (in the economic aspect).

In addition, resource limitations that are often disclosed are in terms of budget. As previously mentioned, not all actors in the supply chain have stable financial conditions. This limited financial capability prevents them from being able to carry out supply chain activities optimally because some efforts to reduce waste require money to purchase tools that can support it. Meanwhile some equipment such as cold storage and bio-digester requires a large amount

of funds, therefore some of the existing equipment in several areas (not industrial areas) are currently also a gift from the government or organization.

Apart from these four general limitations, there are other limitations experienced by supermarkets. According to the store manager of one supermarket, it was stated that the supermarket had made efforts to reduce organic waste. However, due to limited space for waste processing, this program was discontinued.

Thus, it can be seen that the habit of disposing of the waste is the fundamental problems faced by the government in making people utilize waste. However, this change will become even more difficult when the people

Table 2 - CATWOE Analysis

Effective Transition to The Habit Of Utilizing Waste	
Customer	Society (which includes all food supply chain actors)
Actor	Government, educational and research institution, NGO, Society
Transformation	Transitioning new habit by considering the driver and barriers of change
World-wide view	Changing habit can be effectively carried out by considering the basic requirement of a person to achieve and sustain change.
Owner	Government
Environment	Agriculture Supply Chain

themselves are not aware of the problems that is trying to be addressed. Without the awareness of the problem, how society will be able to get involved. In addition, this is also becoming increasingly difficult because at this time people do not feel benefited from these changes and the difficulties in distribution for utilized waste products and limited resources make people increasingly reluctant to make changes in habits.

Therefore, it is necessary to transform the way of changing people's habits in handling waste. CATWOE analysis to be able to make changes in waste handling habits into waste utilization can be seen in the Table II. The CATWOE analysis shows how the ideal system is to produce an effective transition to the habit of utilizing waste.

C. Conceptual Model

Based on the CATWOE analysis, the transformation needed is system to change people's habits to waste utilization. In this research, a conceptual model to achieve the ideal system was built with reference to the ADKAR change management model proposed by Prosci in 1998. The reason for choosing the ADKAR model compared to other models such as the Lewin Change Management Model and the Kotter Management Model is the suitability of the model to be implemented in changes that involve

acceptance by people who must experience the change and the scale of the change carried out [56].

Based on the ADKAR model, the first thing to do to be able to make a change is to build awareness of the people involved in the change. This awareness shows people's understanding of what and why there is a change regarding the reasons for the need for the change and the risks if the change is not made [57]. In the context of making people utilize waste, it is necessary for the actors of change to ensure that people understand the problem of food waste, the urgency of implementing waste utilization and its impact if it is not carried out. Because if the society itself does not aware, there is no reason for people to make changes that usually require more effort than their habits [58].

Building awareness is not only about the massive dissemination of information but also the content of the message to be conveyed so that it can attract attention and in accordance with their concerns [59]. Because as also mentioned by Bada, Sasse and Nurse [60], effective influencing starts from being relevant with the audience. In addition, to build awareness more effectively, the government can work with stakeholders who is able to exert influence such as influencers, community leaders, NGOs, universities, and others depending on the target audience of the message want to be conveyed.

The next step to making changes is to build people's desire to utilize waste. This desire shows the motivation that can make someone willing to participate in making changes [57]. In the context of waste utilization, the actors of change need to understand in advance what the desires or needs of the community can be related to the use of waste so that it may be a motivation for them to make changes [58].

Based on interviews with several actors who have utilized waste, they said that indeed they had a positive impact from the waste utilization, especially on the environmental aspect, but this did not make them consider continuing, except for the interviewees who were workers in supermarkets who had environmental concerns in fulfilling corporate social responsibility. Their current main concern is not the environmental aspect but the economic aspect.

The public's concern for this economic value can be a way for the actors of change to motivate people to use waste. This is because turning waste to have economic value is not impossible if carried out properly [61]. Based on reports on waste utilization programs that have been successfully implemented in several areas. Therefore, the actors of change can start paying more attention to efforts on waste utilization that can have economic value so that it motivates people to make changes in habits.

After making the public aware and interested, the next step is, to begin with, the transition to changing people's behavior, namely providing knowledge to the community about how to use waste. This is necessary because, as previously explained, some informants have the desire to utilize the waste, but due to limited knowledge, they can only dispose of the waste or the farthest effort they can take is throw it into the plantation with the assumption that it has turned into compost, which often ends up being collected again because it hinders the next production process.

The knowledge discussed is not limited to providing theoretical information regarding the use of waste. But also an understanding of the new roles and responsibilities of the changes as well as training and education about the skills needed [57]. In order to make delivery of knowledge can run effectively, there are 4 factors that influence knowledge of change that need to be considered, namely the basic conditions of community knowledge, the ability of the community to learn, resources for delivering education or training and access to knowledge itself [57]. Therefore, just as when trying to build awareness, the actors of change need to know the audience of the people who will receive the knowledge so that it is appropriate.

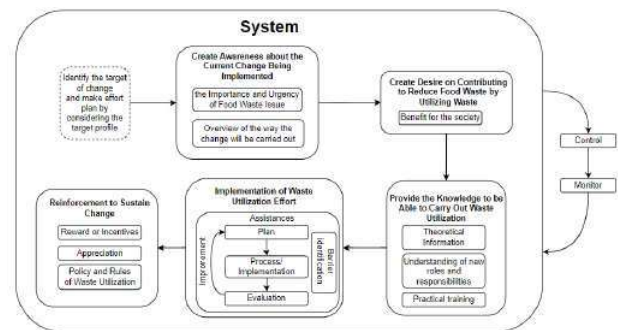


Fig 5 Conceptual Model

After the knowledge possessed by the community is sufficient, the next step is the implementation of the use of the waste itself. This implementation starts from making strategies and implementation plans to evaluating the implementation. This is important for the actors of change to pay attention to because in fact theory and practice often have differences [62].

As previously mentioned, barrier might appear when the community make changes. To be able to make people make changes, the actors of change should actively listen and provide support to the community to deal with these barriers. When people who are the target of the change feel getting empathy, they will be more open and willing to make the change [58]. The support provided can vary from being open to hearing community difficulties to directly

providing assistance in any form such as training, funds, labor assistance, and others. In addition, support in form of assistance can also serve for evaluations. Evaluation is needed in order to make the implementation of change can be improved and done better by the community [63].

In order to make the changes continuously sustain, reinforcement is needed [58]. This reinforcement can be done in various ways, starting from giving rewards, and appreciation or making these changes as mandatory. It is possible for the government to make it a policy because the government has power over it. Making it a policy is recommended for the government considering the fact that sometimes even though all efforts from awareness to ability have been carried out, the absence of an obligation to utilize waste makes people return to the old habit of throwing waste. Several countries, such as China, Taiwan, and Korea, have shown that with strict and clear rules for managing waste, they have succeeded in getting people to participate in making changes to these habits [64]–[66].

Apart from the ADKAR, the actors of change need to understand in advance the target of change, which in the context of this research is the society. As mentioned several times before, at the awareness, desire, knowledge, and implementation stages, the different conditions of each target require a different approach to make the transition to change effective.

Last, the actors of change need to continue to monitor and control efforts to change people's habits towards the utilization of waste because the formation of new habits itself does take time, especially regarding changes on a large scale, and it is necessary to anticipate a decrease in performance from these changes [58]. With monitoring and control, the actors of change can ensure that the efforts made are in accordance with the conditions being experienced so that adjustments can be made.

Thus, the system for changing people's habits to fully utilize waste can be seen in Fig. 5 Conceptual Model.

D. Proposed Recommendation

Followed are the practical recommendation that can be considered by actor of changes for the implementation of better food waste management.

First, collaborating with various parties to conduct extension to overcome the problem of lack of public awareness. The role of the extension itself is to change the way people think and manage something [67]. Collaborating with many experts and stakeholders can be an opportunity to increase education and awareness about food waste. By doing this, it can help both government

and NGOs to manage the limitation in resource.

Second, using social media to build awareness. With the massive use of social media as a communication tool today [68], social media can be an effective medium for disseminating information to increase public awareness. Social media is proven to have a positive impact in raising awareness or contributing to food waste reduction, especially in the stage of consumer [69]. However, in order to make social media an effective tool to increase awareness, there are several things that must be considered, such as the time, the content and the platform used to disseminate the information or invitation.

Last, implementation of circular economy. A circular economy itself is an economic system that forms a cycle to utilize used resources so that the life of a product can be maintained as long as possible which then has an impact on reducing waste and also the use of eventually new resources [70]. With the implementation of a circular economy, the government is not only able to make people do waste processing technically but also responds to the need and desire of the society for economic aspects.

V. CONCLUSION AND FUTURE RESEARCH

Food waste management in Bandung Regency's Agriculture Supply Chain has not been carried out optimally. It can be seen that at each stage of the supply chain there are unsold products which only end up as waste. If analyzed further, not all products are in the same condition and are actually classified as waste. Some of the products that have the potential to become waste still have value that can be utilized by referring to the food waste hierarchy [24]. Even, efforts to utilize these unused products have actually been pursued and supported by several stakeholders. However due to the complexity of food waste problem [41], these efforts have not been able to make supply chain actors implement the utilization of unused product.

Based on the results of the analysis, it was found that the fundamental reason for not implementing the utilization of waste is because it involves changing habits in the society, as also mentioned by Närvänen [41] that the current behavior of society is not used to managing waste. In addition to the consideration of changing habit, barriers and drivers also need to be put attention to as they impact the success of food waste management [46]–[48]. In Bandung Regency's agriculture supply chain, it was found that there are no perceived benefits from the society's perspective, especially in the economic aspect, while it could become the drivers of implementation. Many obstacles in the waste utilization also make people increasingly reluctant to change their habits.

Therefore, to be able to make effective food waste management in Bandung Regency's Agriculture Supply Chain, the root cause of the difficulty of implementing the utilization needs to be addressed first. This study recommends that there be a transformation in its implementation efforts. The transformation is to make this effort as an effort to change people's habits to manage waste, not just a technical implementation.

The transformation of efforts to change the habit of disposing of waste into handling waste is summarized in a conceptual model that was built referring to the ADKAR (Awareness, Desire, Knowledge, Action, Reinforcement) framework [57]. The essence of the conceptual model is to make change efforts by making the target of the perpetrators of the habit change, in this case the society, aware of the change and making the change willingly because not only are there drivers that make them interested, but the barrier in making the change is also removed.

The managerial implication of this study is to provide transitioning strategies for better food waste management in Bandung Regency's Agriculture Supply Chain by involving all stakeholders to participate, especially for the current actor of changes namely government and non-governmental organizations. The actors of change can follow the conceptual model that has been made in this research to create strategies or programs that are related to form community habits in dealing with waste. Some practical ways that can be considered as they could answer the current problems arise in implementing food waste management such as building awareness through extension and social media; and implementation of circular economy to answer the current gap of the absence benefit perceived by the community. By starting to solve the awareness and motivation problem, it is expected that the food waste management can be implemented better and would reduce the number of food waste

For further research, this research can still be deepened in the area of food waste management, starting from identifying other supply chain actors that have not been included in this study. In-depth discussion of the subtopics in this study such as barriers and drivers of each Bandung Regency's agricultural product supply chain actor in managing waste and the success factors of several regions in implementing the programs that have been made by the government in food waste management can also be done to further complement the findings in related topics. Last, this research can also be developed on other topics related to this research. The topics that can be discussed further are the discussion in the potential economic value in the waste utilization which can be evaluated from the cost-benefit analysis. Thus, the discussion on the topic of this research can be more complete and have more implications both theoretically and practically.

REFERENCES

1. UNEP, Food Waste Index Report 2021. 2021.
2. United Nations, "Global Issues: Food." [Online]. Available: <https://www.un.org/en/global-issues/food>. [Accessed: 31-Mar-2022].
3. S. Scherhauser, G. Moates, H. Hartikainen, K. Waldron, and G. Obersteiner, "Environmental impacts of food waste in Europe," *Waste Manag.*, vol. 77, pp. 98–113, Jul. 2018, doi: 10.1016/J.WASMAN.2018.04.038.
4. D. Tonini, P. F. Albizzati, and T. F. Astrup, "Environmental impacts of food waste: Learnings and challenges from a case study on UK," *Waste Manag.*, vol. 76, pp. 744–766, Jun. 2018, doi: 10.1016/J.WASMAN.2018.03.032.
5. Republik Indonesia, Lampiran Peraturan Presiden Republik Indonesia Nomor 18 Tahun 2020 Tentang Rencana Pembangunan Jangka Menengah Nasional 2020-2024. Presiden Republik Indonesia, 2020.
6. Bappeda Kabupaten Bandung, "LOGISTIK PANGAN KABUPATEN BANDUNG," 2020.
7. Kementerian Lingkungan Hidup dan Kehutanan, "Komposisi Sampah 2019 pada Kabupaten Bandung," 2020. [Online]. Available: <https://sipsn.menlhk.go.id/sipsn/public/data/komposisi>. [Accessed: 05-Apr-2022].
8. J. Dai, L. Xie, and Z. Chu, "Developing sustainable supply chain management: The interplay of institutional pressures and sustainability capabilities," *Sustain. Prod. Consum.*, vol. 28, pp. 254–268, Oct. 2021, doi: 10.1016/J.SPC.2021.04.017.
9. S. Chopra and P. Meindl, *Supply Chain Management*, 6th ed. Harlow: Pearson Education Limited, 2016.
10. Y. Lemma, D. Kitaw, and G. Gatew, "Loss in Perishable Food Supply Chain: An Optimization Approach Literature Review," *Int. J. Sci. Eng. Res.*, vol. 5, no. 5, 2014.
11. S. Routroy and A. Behera, "Agriculture supply chain: A systematic review of literature and implications for future research," *J. Agribus. Dev. Emerg. Econ.*, vol. 7, no. 3, pp. 275–302, 2017, doi: 10.1108/JADEE-06-2016-0039.
12. C. C. de Moraes, F. H. de Oliveira Costa, C. Roberta Pereira, A. L. da Silva, and I. Delai, "Retail food waste: mapping causes and reduction practices," *J. Clean. Prod.*, vol. 256, May 2020, doi: 10.1016/J.JCLEPRO.2020.120124.

13. R. Messner, H. Johnson, and C. Richards, "From surplus-to-waste: A study of systemic overproduction, surplus and food waste in horticultural supply chains," *J. Clean. Prod.*, vol. 278, Jan. 2021, doi: 10.1016/J.JCLEPRO.2020.123952.
14. G. Naik and D. N. Suresh, "Challenges of creating sustainable agri-retail supply chains," *IIMB Manag. Rev.*, vol. 30, no. 3, pp. 270–282, Sep. 2018, doi: 10.1016/J.IIMB.2018.04.001.
15. C. Hanson et al., "Food Loss and Waste Accounting and Reporting Stand," 2015.
16. C. Rita Chen, R. J. C Chen, and J. Harris Bldg, "Using Two Government Food Waste Recognition Programs to Understand Current Reducing Food Loss and Waste Activities in the U.S. Center for Sustainable Business and Development," *Sustainability*, vol. 10, 2018, doi: 10.3390/su10082760.
17. A. Y. Ali, J. M. Hassen, and G. G. Wendem, "Forecasting as a Framework for Reducing Food Waste in Ethiopian University Canteens," *J. Appl. Res. Ind. Eng.*, vol. 6, no. 4, pp. 374–380, Dec. 2019.
18. D. Prusky, "Reduction of the incidence of postharvest quality losses, and future prospects," *Food Secur.*, pp. 463–474, 2011, doi: 10.1007/s12571-011-0147-y.
19. E. Surucu-Balci and O. Tuna, "Investigating logistics-related food loss drivers: A study on fresh fruit and vegetable supply chain," *J. Clean. Prod.*, vol. 318, p. 128561, Oct. 2021, doi: 10.1016/J.JCLEPRO.2021.128561.
20. S. Thapa Karki, A. C. T. Bennett, and J. L. Mishra, "Reducing food waste and food insecurity in the UK: The architecture of surplus food distribution supply chain in addressing the sustainable development goals (Goal 2 and Goal 12.3) at a city level," *Ind. Mark. Manag.*, vol. 93, pp. 563–577, Feb. 2021, doi: 10.1016/J.INDMARMAN.2020.09.019.
21. O. D. Elisha, "Moving Beyond Take-Make-Dispose to Take-Make-Use for Sustainable Economy," *Int. J. Sci. Res. Educ.*, vol. 13, no. 3, pp. 497–516, 2020.
22. M. Borrello et al., "Consumers' Perspective on Circular Economy Strategy for Reducing Food Waste," *Sustainability*, vol. 9, 2017, doi: 10.3390/su9010141.
23. M. ; Wiprächtiger, M. ; Haupt, M. ; Rapp, and S. Hellweg, "Waste not, want not – ambiguities around waste and waste prevention," *Resour. Conserv. Recycl.*, vol. 173, 2021, doi: 10.3929/ethz-b-000491585.
24. D. A. Teigiserova, L. Hamelin, and M. Thomsen, "Towards transparent valorization of food surplus, waste and loss: Clarifying definitions, food waste hierarchy, and role in the circular economy," *Sci. Total Environ.*, vol. 706, Mar. 2020, doi: 10.1016/J.SCITOTENV.2019.136033.
25. C. Cicatiello, S. Franco, B. Pancino, and E. Blasi, "The value of food waste: An exploratory study on retailing," *J. Retail. Consum. Serv.*, vol. 30, pp. 96–104, May 2016, doi: 10.1016/J.JRETCONSER.2016.01.004.
26. K. L. Thyberg and D. J. Tonjes, "Drivers of food waste and their implications for sustainable policy development," *Resour. Conserv. Recycl.*, vol. 106, pp. 110–123, Jan. 2016, doi: 10.1016/J.RESCONREC.2015.11.016.
27. Food and Agriculture Organization of the United Nations, "The State of Food Security and Nutrition in the World 2021," *State Food Secur. Nutr. World 2021*, Jul. 2021, doi: 10.4060/CB4474EN.
28. A. Karin Östergren et al., "FUSIONS Definitional Framework for Food Waste (Full Report)," Jul. 2014.
29. G. Garcia-Garcia, · Elliot Woolley, S. Rahimifard, J. Colwill, · Rod White, and · Louise Needham, "A Methodology for Sustainable Management of Food Waste," *Waste Biomass Valor.*, vol. 8, pp. 2209–2227, 2017, doi: 10.1007/s12649-016-9720-0.
30. G. Garcia-Garcia, E. Woolley, and S. Rahimifard, "A Framework for a More Efficient Approach to Food Waste Management," *Int. J. Food Eng.*, vol. 1, no. 1, pp. 65–72, 2015, doi: 10.18178/ijfe.1.1.65-72.
31. S. Nikolicic, M. Kilibarda, M. Maslaric, D. Mircetic, and S. Bojic, "Reducing Food Waste in the Retail Supply Chains by Improving Efficiency of Logistics Operations," 2021, doi: 10.3390/su13126511.
32. N. Kafa and A. Jaegler, "Food losses and waste quantification in supply chains: a systematic literature review," *Br. Food J.*, vol. 123, no. 11, pp. 3502–3521, 2021, doi: 10.1108/BFJ-09-2020-0879/FULL/XML.
33. C. Chauhan, A. Dhir, M. U. Akram, and J. Salo, "Food loss and waste in food supply chains. A systematic literature review and framework development approach," *J. Clean. Prod.*, vol. 295, May 2021, doi: 10.1016/J.JCLEPRO.2021.126438.
34. G. Garcia-Garcia, E. Woolley, and S. Rahimifard, "A Framework for a More Efficient Approach to Food Waste Management," *ETP Int. J. Food Eng.*, 2015, doi: 10.18178/IJFE.1.1.65-72.

35. E. Papargyropoulou, R. Lozano, J. K. Steinberger, N. Wright, and Z. Bin Ujang, "The food waste hierarchy as a framework for the management of food surplus and food waste," *J. Clean. Prod.*, vol. 76, pp. 106–115, Aug. 2014, doi: 10.1016/J.JCLEPRO.2014.04.020.
36. S. Corrado, F. Ardente, S. Sala, and E. Saouter, "Modelling of food loss within life cycle assessment: From current practice towards a systematisation," *J. Clean. Prod.*, vol. 140, pp. 847–859, Jan. 2017, doi: 10.1016/J.JCLEPRO.2016.06.050.
37. M. Bagherzadeh, M. Inamura, and H. Jeong, "Food Waste Along The Chain," 2014.
38. E. Papargyropoulou, R. Lozano, J. K. Steinberger, N. Wright, and Z. Bin Ujang, "The food waste hierarchy as a framework for the management of food surplus and food waste," *J. Clean. Prod.*, vol. 76, pp. 106–115, Aug. 2014, doi: 10.1016/J.JCLEPRO.2014.04.020.
39. J. V. Vljajic, R. Mijailovic, and M. Bogdanova, "Creating loops with value recovery: empirical study of fresh food supply chains," *Prod. Plan. Control*, vol. 29, no. 6, pp. 522–538, Apr. 2018, doi: 10.1080/09537287.2018.1449264.
40. D. Pleissner, "Recycling and reuse of food waste," *Curr. Opin. Green Sustain. Chem.*, vol. 13, pp. 39–43, Oct. 2018, doi: 10.1016/J.COGLSC.2018.03.014.
41. E. Närvänen, N. Mesiranta, M. Mattila, and A. Heikkinen, "Food Waste Management: Solving the Wicked Problem," 2019.
42. A. L. Allison, F. Lorencatto, S. Michie, and M. Miodownik, "Barriers and Enablers to Food Waste Recycling: A Mixed Methods Study amongst UK Citizens," *Int. J. Environ. Res. Public Health*, vol. 19, no. 5, Mar. 2022, doi: 10.3390/IJERPH19052729.
43. H. Sasnovich, "WASTE MANAGEMENT IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT," *J. Contemp. Econ.*, vol. 3, no. 3, 2018.
44. V. Filimonau and V. A. Ermolaev, "Mitigation of food loss and waste in primary production of a transition economy via stakeholder collaboration: A perspective of independent farmers in Russia," *Sustain. Prod. Consum.*, vol. 28, pp. 359–370, Oct. 2021, doi: 10.1016/J.SPC.2021.06.002.
45. R. Diaz-Ruiz, M. Costa-Font, F. López-i-Gelats, and J. M. Gil, "Food waste prevention along the food supply chain: A multi-actor approach to identify effective solutions," *Resour. Conserv. Recycl.*, vol. 149, pp. 249–260, Oct. 2019, doi: 10.1016/J.RESCONREC.2019.05.031.
46. E. Graham-Rowe, D. C. Jessop, and P. Sparks, "Identifying motivations and barriers to minimising household food waste," *Resour. Conserv. Recycl.*, vol. 84, pp. 15–23, Mar. 2014, doi: 10.1016/J.RESCONREC.2013.12.005.
47. A. Wakefield and S. Axon, "I'm a bit of a waster': Identifying the enablers of, and barriers to, sustainable food waste practices," *J. Clean. Prod.*, vol. 275, Dec. 2020, doi: 10.1016/J.JCLEPRO.2020.122803.
48. S. V. Russell, C. W. Young, K. L. Unsworth, and C. Robinson, "Bringing habits and emotions into food waste behaviour," *Resour. Conserv. Recycl.*, vol. 125, pp. 107–114, 2017, doi: 10.1016/J.RESCONREC.2017.06.007.
49. P. Checkland, "Soft Systems Methodology," *Hum. Syst. Manag.*, vol. 8, no. 4, pp. 273–289, 1989, doi: 10.1007/978-1-349-14931-5_26.
50. A. Monk and S. Howard, "The Rich Picture: A Tool for Reasoning About Work Context," *ACM, INC.*, 1998, pp. 21–30.
51. A. Platt and S. Warwick, "Review of soft systems methodology," *Ind. Manag. Data Syst.*, vol. 95, no. 4, pp. 19–21, 1995, doi: 10.1108/02635579510086698.
52. P. Checkland and C. Tsouvalis, "Reflecting on SSM: The Link Between Root Definitions and Conceptual Models," *System Research and Behavioural Science*, 1997. [Online]. Available: [https://sci-hub.mkxa.top/https://doi.org/10.1002/\(SICI\)1099-1743\(199705/06\)14:3%3C153::AID-SRES134%3E3.0.CO;2-H](https://sci-hub.mkxa.top/https://doi.org/10.1002/(SICI)1099-1743(199705/06)14:3%3C153::AID-SRES134%3E3.0.CO;2-H). [Accessed: 15-Jun-2022].
53. A. Basden and A. T. Wood-Harper, "A philosophical discussion of the root definition in soft systems thinking: An enrichment of CATWOE," *Syst. Res. Behav. Sci.*, vol. 23, no. 1, pp. 61–87, Jan. 2006, doi: 10.1002/SRES.689.
54. M. Skjott Linneberg and S. Korsgaard, "Coding qualitative data: a synthesis guiding the novice," *Qual. Res. J.*, vol. 19, no. 3, pp. 259–270, Jun. 2019, doi: 10.1108/QRJ-12-2018-0012.
55. "Informasi Kinerja Pengelolaan Lingkungan Hidup Daerah (IKPLHD) Kabupaten Bandung Tahun 2019," 2020.
56. B. J. Galli, "Comparison of Change Management Models: Similarities, Differences, and Which Is Most Effective?," *Innov. Technol. Knowl. Manag.*, pp. 605–624, 2019, doi: 10.1007/978-3-030-15409-7_24.
57. J. M. Hiatt, *ADKAR: A Model for Change in Business*,

- Government, and Our Community. Prosci Learning Center Publications, 2006.
58. T. G. Cummings and C. G. Worley, *Organization Development and Change*, 11th ed. Cengage Learning, 2018.
59. D. Pearson and A. Perera, "Reducing Food Waste: A Practitioner Guide Identifying Requirements for an Integrated Social Marketing Communication Campaign," *Soc. Mar. Q.*, vol. 24, no. 1, pp. 45–57, Mar. 2018, doi: 10.1177/1524500417750830.
60. M. Bada, A. M. Sasse, and J. R. C. Nurse, "Cyber Security Awareness Campaigns: Why do they fail to change behaviour?," in *International Conference on Cyber Security for Sustainable Society*, 2015, 2015.
61. K. A. Darto et al., "Best Practices of Solid Waste Management in Indonesia," Jakarta, 2007.
62. E. Carter, "Successful Change Requires More Than Change Management," *J. Qual. Particip.*, vol. 31, no. 1, pp. 20–23, 2008.
63. L. T. Le, B. J. Anthony, S. M. Bronheim, C. M. Holland, and D. F. Perry, "A Technical Assistance Model for Guiding Service and Systems Change," *J. Behav. Heal. Serv. Resear.*, vol. 43, no. 3, 2016, doi: 10.1007/s11414-014-9439-2.
64. T. C. Kuo, N. Y. Hsu, R. Wattimena, I. H. Hong, C. J. Chao, and J. Herlianto, "Toward a circular economy: A system dynamic model of recycling framework for aseptic paper packaging waste in Indonesia," *J. Clean. Prod.*, vol. 301, Jun. 2021, doi: 10.1016/J.JCLEPRO.2021.126901.
65. S. Lee and H. S. Paik, "Korean household waste management and recycling behavior," *Build. Environ.*, vol. 46, no. 5, pp. 1159–1166, May 2011, doi: 10.1016/J.BUILDENV.2010.12.005.
66. B. Su, A. Heshmati, Y. Geng, and X. Yu, "A review of the circular economy in China: Moving from rhetoric to implementation," *J. Clean. Prod.*, vol. 42, pp. 215–227, 2013, doi: 10.1016/J.JCLEPRO.2012.11.020.
67. L. H. McCoy, "Extension's Role in the United States' Campaign to Reduce Food Waste," *J. Ext.*, vol. 57, no. 2, pp. 4–5, 2019.
68. "Statistik Telekomunikasi Indonesia," 2019.
69. E. L. Jenkins, L. Brennan, A. Molenaar, and T. A. McCaffrey, "Exploring the application of social media in food waste campaigns and interventions: A systematic scoping review of the academic and grey literature," *J. Clean. Prod.*, vol. 360, p. 132068, Aug. 2022, doi: 10.1016/J.JCLEPRO.2022.132068.
70. C. Ingrao, N. Faccilongo, L. Di Gioia, and A. Messineo, "Food waste recovery into energy in a circular economy perspective: A comprehensive review of aspects related to plant operation and environmental assessment," *J. Clean. Prod.*, vol. 184, pp. 869–892, May 2018, doi: 10.1016/J.JCLEPRO.2018.02.267.